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# Harnessing biomedical research to health needs

Any serious consideration of the contribution of medical research to world health must take in the general history of the health sciences over the past century. The pioneering work of Pasteur and Koch a hundred years ago revealed the role of specific infectious agents in communicable disease and thus laid the foundations for rational sanitation and hygiene, as well as the development of preventive vaccines, followed by that of therapeutic antibiotics. The enormous improvement in public health in developed countries, culminating in the 1950s, is directly due to the widespread application of principles and techniques derived from their research.

Since 1950, a second cycle of health research, mainly government-sponsored, has helped to bring about a profound understanding of cell biology, of microbes, and of viruses. The work carried out on DNA, the genetic core of the cell, may stand as its symbol. It has coincided with a wave of sophisticated innovations in medical and surgical practice, like the psychotropic drugs and coronary bypass surgery. Until about 1980, links between these two kinds of medical research—fundamental and applied—were relatively few, and many practical advances originated in empirical insights, which were then elaborated with the aid of more fundamental knowledge. In the third cycle, now in progress, practical advances are being increasingly combined with DNA-oriented research on such problems as schizophrenia, heart disease, ulcers, diabetes and sickle-cell disease.

Infectious disease nevertheless remains the principal health problem of the developing countries and hence of most of the world's population. Most recent health research has accordingly held little relevance for the least developed countries, whose main problem, despite substantial progress, may be viewed as the application of knowledge already well established in the 1950s. There has thus been some skepticism about the role of research in WHO's program—though in fact, apart from two or three specially funded programs, research accounts for a relatively small part of the Organization's budget.

Medical research certainly does have a role to play in efficiently adapting existing knowledge to the needs of individual countries and cultures, in dealing with those diseases that are particularly prevalent in the least developed countries (notably parasitic diseases), and especially in exploring the extraordinary opportunities now opened up by modern molecular biology.

Despite attempts to express the relationship between science and health in quantitative terms it is difficult to achieve more than a rough idea of it. The radical improvement in child health, of course, has its roots in the microbiological research carried out since 1880. My question confines itself to a narrower time-span: what part of the medical knowledge scientifically accumulated *since 1950* has been of cardinal importance in world public health?

The basic principles of vaccination were established long ago, but a practical means of producing vaccines for viral afflictions like poliomyelitis had to await the advances in cell and tissue culture made during the 1950s. The most celebrated example, smallpox vaccination, also has the longest history. Political determination and operational know-how played at least as important a part as recent laboratory investigations in the success of the worldwide campaign against smallpox. Nevertheless, scientific means of ensuring the efficacy of vaccines in widely varying circumstances and of preserving their potency were indispensable to its success. Of particular importance for any further efforts to eradicate an infectious disease is an understanding of its natural history so that the means employed may be closely attuned to the goal. This will strain our basic knowledge of the genetics and evolution of most virus diseases.

The theory of the bacterial toxin was one of the great conceptual advances made by the pioneer microbiologists, i.e., the explanation of virulence by the invading microbe's production of a specific toxic chemical. The presence of a specific lethal toxin explains many dangerous infections, from yesteryear's diphtheria to today's toxic shock syndrome. For many years, it also misled many scientists as regards the devastation caused by cholera. The cholera vibrio, like the bacteria responsible for the related and equally dangerous enteric infections of infancy, does indeed produce a toxin, but it is not demonstrable by the traditional method of injecting culture broth into a guinea-pig. Not until the work of Indian researchers in 1959 did we learn that the cholera toxin is essentially harmless when injected, for its main effect on the body is to stimulate secretion of water into the gut. The resultant diarrhea may be so malignant, nevertheless, as to turn the blood into a dehydrated sluggish paste, leaving further terrible symptoms in its wake. Most cases of cholera can now be treated by simple rehydration with water plus salt and sugar. Thus sophisticated research has led to simple, practical measures that have already

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rescued thousands, if not millions, of lives, in cholera epidemics throughout the world and in modern pediatric nurseries in the most advanced countries.

With the reduction of infant mortality (also linked with spasmodic and geographically disparate improvements in agriculture), most of the least developed countries have experienced a relative population explosion, which has in turn imperilled the possibility of social and economic advance. Oral and injectable contraceptives, based on the most advanced chemical and endocrinological principles, have been important ingredients of the scattered successes achieved in countering this threat. That social and political factors are of prime importance in deciding the outcome should not distract attention from the desperate need to develop contraceptive methods still better suited to the requirements of particular countries and free from the disadvantage of possible side effects. The lack of such methods is often used as an excuse for not pursuing humane and sensible programs of family planning and population control.

The confusion surrounding the alleged risk of cancer and other side effects from oral contraceptives and the resultant cost to orderly development are typical of a whole range of problems that have arisen in the course of adjustment to industrial modernization. These include the effects of cigarette-smoking on health, the hazards presented by the pesticides used to promote agricultural efficiency and control disease vectors, and the pollution created by the air- and waterborne emissions attendant on factory production and mineral extraction. In assessing pollution, science has reached a half-way point, namely in the development of exquisitely sensitive analytical methods that can point to possible risks everywhere in our man-modified environment. Unfortunately we are not very far advanced in the precise risk-benefit calculations that will be urgently needed in order to make the right choices, especially where economic factors are as serious constraints as they are for the least developed countries.

Looking now to the future, the gradually improving health and living standards of the developing countries are bringing them closer to the problems and opportunities of the industrial countries. There will be an ever-increasing emphasis on research on their growing problems of heart disease and cancer, not to mention psychiatric illness and viral infections. Of the highest importance in all these areas is DNA-oriented research, which can, for example, furnish details on the structure and regulation of the lipoproteins, the substances most intimately involved in depositing cholesterol in the coronary arteries. This work should lead fairly promptly to more rational dietary and pharmacological measures to control a leading cause of death—and to engender the still more perplexing problem of the welfare of ever older (though not necessarily more robust) populations. Current research on the "oncogene" does not point quite so directly to specific measures against cancer, and we are still a long way from understanding the basic causes of schizophrenia and depression. Nevertheless, there can be little doubt that we are in a stage of renewed advance comparable only to the emergence of the scientific investigation of infectious disease 100 years ago. It is gratifying to see the renewed attention also being given to the problems of parasitic disease at every level, including the emphasis on the application of molecular biology, greatly inspired by WHO's Special Program for Research and Training in Tropical Diseases.

There are still ominous clouds on the horizon, however. While modern research can refine health-promoting measures so as to facilitate their application in the least developed countries, the best vaccine is useless if there is neither the will nor the infrastructure to disseminate it. We have yet to see the universal commitment to health improvement—and to the most effective forms of research to support it—that might allow such possibilities to be realized.

For some years, I have warned that the microbial world has not ceased to evolve, and that it would be rash to imagine that the great pandemics of history can never be repeated. The current example of AIDS unhappily reminds us how quickly new diseases can emerge, and how limited is our capacity to understand them promptly and provide a defense against them. In its present form, AIDS appears to spread very slowly and inefficiently, and there is every reason to expect that it will be contained before it dominates the public health statistics of any country. We have due warning, however, that our quest for fundamental knowledge in virology is not an idle game but a precondition for ensuring the welfare of the human species everywhere.

With nature's harshness all around us, it is all the more tragic that calculated man-made epidemics remain a grave threat. This threat provided a major incentive for the negotiation of the Biological Weapons Disarmament Treaty of 1972, in which WHO played an important role by spelling out the underlying human necessity. Regrettably many problems remain in the enforcement of this treaty, so that we cannot ignore the danger of man-engineered and man-disseminated disease on top of all the other plagues that already impose so heavy a burden on world health. □